Dental Traumatology

Dental Traumatology 2009; **25**: e32–e36; doi: 10.1111/j.1600-9657.2008.00745.x

The use of calcium hydroxide and mineral trioxide aggregate on apexification of a replanted tooth: a case report

CASE REPORT

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Abstract – *Aim*: To report the outcome of the endodontic treatment of a reimplanted central maxillary incisor with open apex after 8 years and 7 months of follow-up. *Summary*: This case report presents the treatment of a right central maxillary incisor of an 8-year old white male patient with history of traumatic avulsion and immediate replantation. The endodontic therapy consisted of periodical changes of calcium hydroxide dressing and a definitive root canal filling with mineral trioxide aggregate (MTA). The treatment was successful without pathologies up to 7 years of follow-up. After the institution of orthodontic treatment a localized and late root resorption was noticed at the last radiographic examination (8 years and 7 months postoperative follow-up). Moreover, the use of MTA promoted a mild crown grey discoloration.

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Accepted 13 September, 2008

Key learning points

- The immediate replantation of an avulsed tooth combined with endodontic treatment was fundamental to ensure a clinical success, maintaining the affected tooth for at least 8 years and 7 months.
- The alkaline environment provided by calcium hydroxide and mineral trioxide aggregate (MTA) is important for preventing resorptions in traumatized teeth.
- Orthodontic treatment after replantation had possibly an important role on the late and localized area of root resorption observed after 8 years and 7 months.
- Despite the favourable biological properties of MTA, a mild crown discoloration was found on follow-up examination.

Avulsion is one of the dental injuries characterized by the complete displacement of the tooth from its socket, causing damage to the supporting tissues and to the vasculo-nervous structures. The rupture of periodontal fibres frequently occurs and part of these fibres adheres to the dental cementum, while the other part remains in the alveolar bone (1, 2).

Loss of pulpal vitality is a common undesirable finding in avulsed teeth. Teeth with incomplete apex, which are replanted less than 60 min, can heal through pulpal revascularization (3, 4). However, the healing process does not often occur due to the fact that the apical tissue is highly susceptible to bacterial contamination (5).

In cases of pulpal necrosis and gangrene, it is mandatory to use specific dressing materials, aimed at neutralizing bacteria and their by-products, as well as stimulating the formation of a mineralized apical barrier through a process called apexification.

Many products are used as root canal dressing for apexification; however, due to the favourable biological performance and antibacterial action, calcium hydroxide has been reported as the material of choice (4–8). The literature recommends repeated dressing changes for a period of 5–20 months in order to induce calcified barrier in the apical region (9).

Mineral trioxide aggregate (MTA) was introduced in the market as a new alternative method for apexification because this material is composed of several minerals including calcium oxide. This definitive material has good physicochemical properties, presents biocompatibility and can be applied in a wet environment (5).

The aim of the present report was to show a long-term follow-up of an avulsed permanent incisor on a young patient treated with calcium hydroxide and MTA.

Report

An 8-year-old boy was presented for emergency treatment after an accident in a soccer game, with a traumatic

avulsion of his right maxillary central incisor that occurred in September 1999.

Due to fact that it was the second accident involving his teeth, his parents immediately cleaned the avulsed tooth with tap water, replanted it into the socket and sought professional care. In the emergency service, the replanted tooth was repositioned using a semi-rigid fixation by means of two brackets and an orthodontic wire (Fig. 1). No endodontic procedure was carried out in this visit.

Ten days later, the patient was directed to a specialized endodontic service. The tooth was submitted to coronal access and manual cleaning and shaping with constant irrigation with 1% sodium hypochlorite. Afterwards, the root canal was dried and a solution of buffered 14% ethylene diamine tetraacetic acid (Odhacam/Dentsply, Rio de Janeiro, Brazil) was applied into the pulpal chamber for 3 min. A calcium hydroxide dressing material (Calen; SSW Artigos Dentários, Rio de Janeiro, Brazil) was inserted into the root canal.

Periodic changes of the root canal dressing material were made for 18 months. After this period, on a follow-up visit, a radiographic examination revealed a mineralized bridge formation (Fig. 2), noticed also in manual probing of the root canal.

MTA (ProRoot Denstsply/Maillefer) was chosen for root canal filling, due to its favourable biological and physicochemical properties. The material was placed into the root canal in half of the working length with the aid of an amalgam carrier and a manual plugger, resulting in a 7-mm apical plug (Fig. 3). The crown of the tooth was then restored with composite.

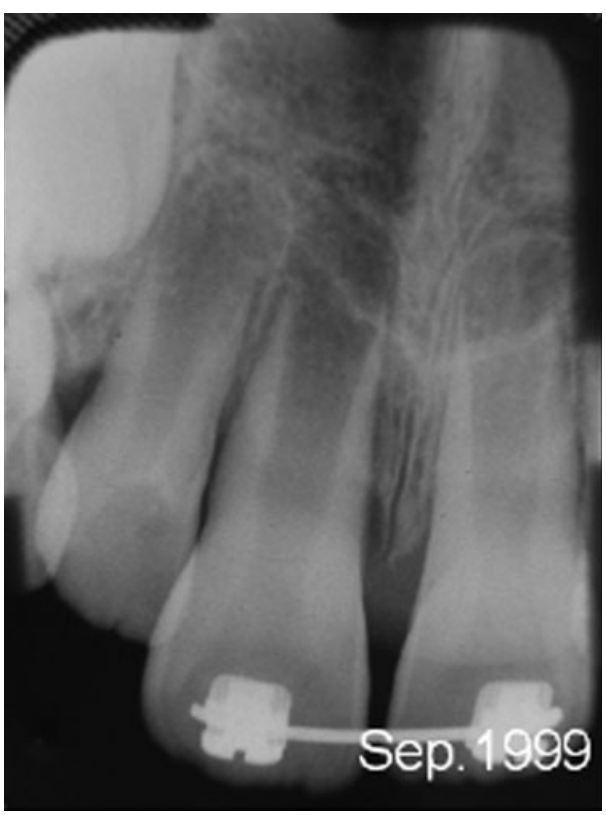

Fig. 1. Preoperative radiograph. Replanted tooth and fixed with two brackets and an orthodontic wire (Sep. 1999).

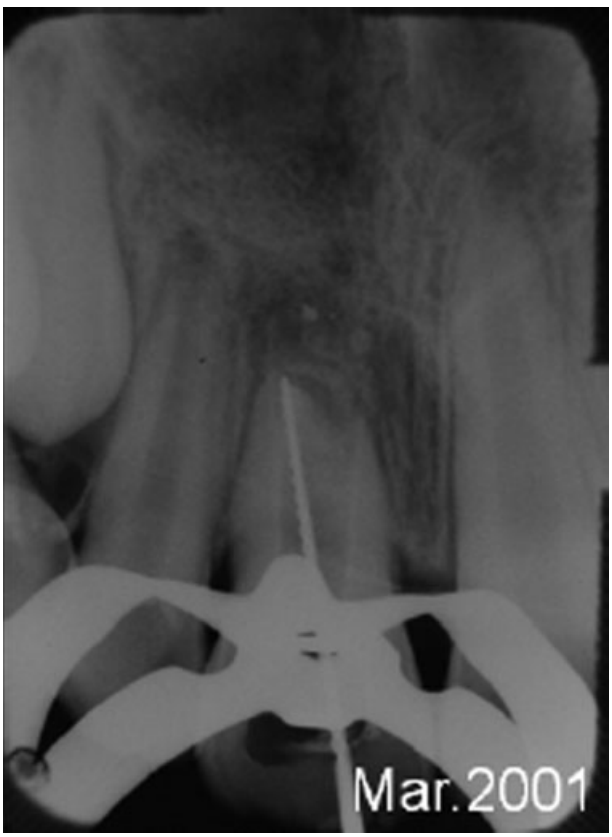

Fig. 2. One and half year follow-up radiograph reveals a mineralized bridge, noticed upon manual probing of the root canal (Mar. 2001).

Since the initial visit, the patient was invited for periodical follow-up visits in order to confirm the healing process. The successful result of this case was verified by the absence of clinical symptoms and by follow-up radiographs (Figs 4–6). After the treatment a mild grey crown discoloration was noticed in the follow-up (Fig. 7). Seven years after replantation, orthodontic treatment was instituted. At the 8 years and 7 months follow-up radiograph, a late and localized root resorption was observed (Fig. 8).

Discussion

According to Flores et al. (4) avulsion of permanent teeth is the most serious of all dental injuries, and replantation is the treatment of choice. Besides repositioning the tooth into its socket, it is necessary to insert an alkaline dressing based on calcium hydroxide to obtain apical closure and avoid root resorption (4–8).

In cases of dental avulsion, the immediate replantation of the tooth or its maintenance in a moistened medium followed by semi-rigid fixation for 7–10 days are recommended procedures for the success of the case (3, 4). To prevent root resorption after these procedures, the removal of the necrotic tissue and the use of calcium hydroxide into root canal are mandatory.

Fig. 3. Immediate post-treatment radiograph (Mar. 2001).

Fig. 4. Five and half years follow-up radiograph. Orthodontic treatment was instituted (Mar. 2005).

Fig. 5. Six years and 8 months follow-up radiograph (May 2006).

Morse et al. (10) studied some methods of root canal treatment of teeth with incomplete apical closure and pulpal necrosis. They concluded that the success of the treatment, expressed by the apical healing, is due to the antibacterial action and induction of calcification caused by this material.

Cvek (11) reached 96% of success in cases of apexification with long-term treatment with calcium hydroxide. The author reported that its alkaline pH and physical presence inside the root canal represent an effective antibacterial effect by inhibiting osteoclastic activity, avoiding the penetration of granulation and exudate tissue, and by forming a hard tissue barrier.

The present clinical report was the first treatment performed by its authors using MTA. Although the authors were aware of its good properties, the access to this material in Brazil was still difficult. This explains the long-term treatment with root canal dressing and periodical changes of calcium hydroxide.

Presently, the indication of MTA in one visit is an alternative procedure for apexification treatment without intermediary dressings (12).

In a similar clinical report, Villa and Fernández (5) obtained a successful radiographic result using calcium hydroxide as the dressing material and MTA as the filling material. However, dental staining caused by the use of MTA was not discussed in this study. Jacobovitz and Lima (13) highlighted this adverse effect of MTA, even when using a white material. This detail cannot be

Fig. 6. Seven and half years follow-up radiograph. (Mar. 2007).

Fig. 7. Clinical aspect after 7½ years follow-up, showing tooth discoloration (Mar. 2007).

disregarded, as most of the avulsed teeth involve the patient's appearance and aesthetics.

Trope (3) recommends that the ideal period of follow-up should occur every 6 months for 5 years and yearly for as long as possible. Until the eighth year of follow-up the present case showed a normal clinical and radiographic behaviour; however, after the ninth year follow-up radiograph, a late and localized root resorption was noticed.

Fig. 8. Eight and half years follow-up radiograph, showing a late and localized area of root resorption (April 2008).

The orthodontic treatment is a risk factor for root resorption. According to Pizzo et al.(14), the orthodontically induced inflammatory root resorption is due to the pressure applied to the root during the movement that produces an ischaemic necrosis of the periodontal ligament localized in the pressure area. A scavenger activity of macrophages is established in order to eliminate the necrotic tissues. The first cells to be involved in the removal of this necrotic tissue, known as hyaline zone, are macrophage-like cells, which are most probably activated by signals coming from this site (15). The orthodontic force on this post-trauma case may be responsible for such an occurrence.

Despite the negative aspects shown in the last radiograph, the treatment played an important role in the maintenance of the tooth for a long period and must be encouraged. Excessive use of orthodontic forces should be avoided to prevent postoperative complications.

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